Ourston Roundabout Engineering

July 16, 2010

Maine Bureau of Transportation Systems Planning
16 State House Station
Augusta, ME 04333-0016

Attention: Mr. Darryl Belz, P.E.

Dear Darryl:

Re: Roundabout Operational Analysis and Design Services
Proposed Roundabout at Civic Center Drive/Old Belgrade Rd/Bog Rd
Augusta, Maine
Ourston Project Number: 09909

We have completed an operational analysis and conceptual design for a proposed roundabout to be located at the intersection of Civic Center Drive, Old Belgrade Road, and Bog Road in Augusta, Maine. The projected peak hour traffic volumes for the build year 2028 Midday and PM peak hours, developed by Gorrill-Palmer Consulting Engineers, were used in the traffic analysis. The volumes were taken from pages 19 and 20 of the traffic report, shown in Figures A1 and A2.

At this stage of the investigation into alternative intersection control, there is sufficient evidence to recommend consideration of a roundabout in this location to accommodate traffic increase and associated roadway network improvements. We have provided an initial screening of the intersection quantifying the performance characteristics of a roundabout based on operations and property impacts.

Roundabout Capacity Analysis

The traffic operations for the intersection were analyzed using RODEL 1.9.7 roundabout design and capacity analysis software. The 50th percentile confidence level (CL) was used in the RODEL capacity analysis to represent the most probable capacity of the roundabout, and to be consistent with confidence level inherent in typical signalized and unsignalized capacity analysis methodologies. Similarly, average delay, as opposed to maximum delay, was used to be consistent with signalized and unsignalized methodologies. We have also performed capacity analysis at an 85 percent confidence level to determine if the forecasted level of service and average delay is predicted to be in the sensitive area of the delay curve.

A single lane roundabout configuration was considered with single lane entries on all legs. The capacity analysis indicates that the single lane roundabout would perform acceptably up to **122% of the Midday peak volume** and up to **80% of the PM peak volume**.

To provide acceptable operations for the build year 2028 volumes, a multi-lane roundabout will be required. The layout of the intersection would be a multi-lane roundabout with two lane entries on Northbound Civic Center Drive and Northwestbound Old Belgrade Road and single lane entries on Southbound Civic Center Drive and Bog Road. Although the capacity prediction does not require it, a partial right-turn bypass lane could be constructed on Southbound Civic Center Drive to

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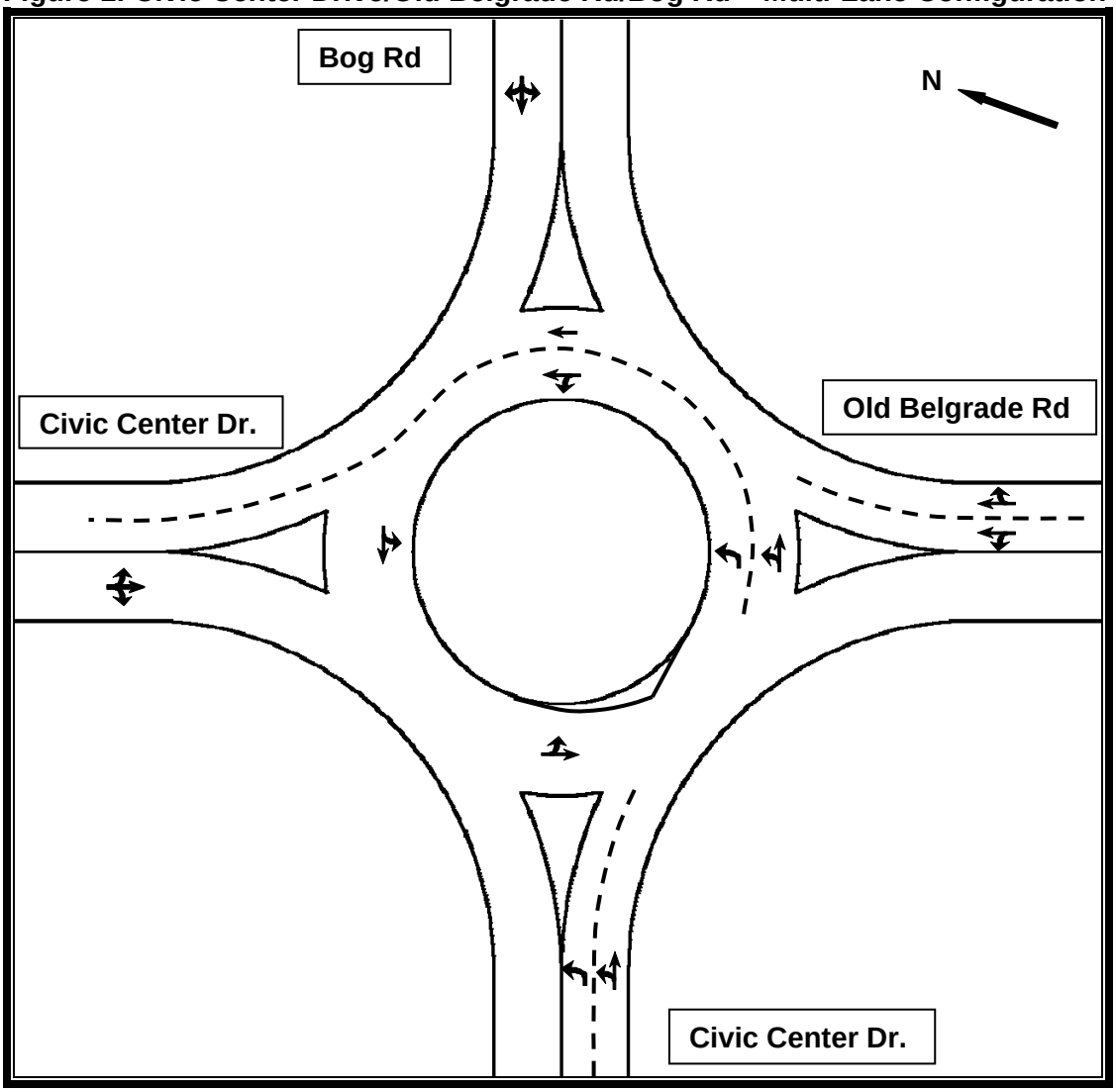
accommodate the high volume of traffic making this movement. A sketch of the required roundabout lane configuration requirements is shown in Figure 1.

Figure 1: Civic Center Drive/Old Belgrade Rd/Bog Rd – Multi-Lane Configuration



The RODEL capacity analysis data is documented in Figures A3 through A6 for the 2028 Midday and PM volumes.

The lane configuration's levels of service and delay for the overall intersection and each approach are listed in Table 1.

Table 1: Civic Center Drive/Old Belgrade Rd/Bog Rd – 2028 Volumes

Civic Center Drive / Old Belgrade Road / Bog Road - 2028 Volumes - Capacity Analysis Summary											
		Intersection		Average Delay By Approach							
				Civic Center SB		Civic Center NB		NWB Old Belgrade		SWB Bog Rd	
		Level of Service	Average Delay	Level of Service	Average Delay	Level of Service	Average Delay	Level of Service	Average Delay	Level of Service	Average Delay
Midday	50%	A	6.2	B	11.4	A	3.3	A	2.9	A	6.2
	85%	B	14.1	D	33.4	A	4.0	A	3.5	A	9.6
PM	50%	A	6.0	A	5.6	A	6.3	A	5.1	A	8.8
	85%	A	9.3	A	8.1	A	9.9	A	7.2	C	18.1
LOS Source: 2000 Highway Capacity Manual - Unsignalized Intersections											*Delay in Seconds*

An operational sensitivity analysis was conducted to estimate the point of unacceptable operations for the proposed lane configuration. The 2028 traffic volumes were consistently increased to a point where any leg of the roundabout would reach a Level of Service of E (35 seconds of delay) at 50% CL. The results show that the multi-lane roundabout would operate acceptably up to **122% of the Midday peak volume** and up to **130% of the PM peak volume**.

A summary of the operational analysis is also shown in Figure A7.

Roundabout Conceptual Design

The conceptual roundabout design has an inscribed circle diameter (ICD) of 165 feet. A partial right-turn bypass lane is an optional element for Southbound Civic Center Drive to accommodate the high volume of traffic making this movement. Two alternatives have been developed showing two different circle locations. Each alternative has a set of challenges to maintain access to the adjacent properties; we have shown the two options to demonstrate the impacts of changes in the circle location. Shifting the circle location and the associated approach alignments influences the ability to maintain accessibility of the surrounding land parcels. A cost estimate detailing the costs of property acquisition and access road construction should be completed at the next stage of the design process to determine the most cost effective circle location. After a general cost estimate has been conducted, a more refined approach to the roundabout design optimization can be completed. The conceptual design of the roundabout is shown in Figures B1 and B2.

The roundabout concepts were developed to accommodate large trucks (WB-67), provide adequate sight distance and vision outlook, and provide natural vehicle paths. The entry geometry of the roundabout was designed to deflect traffic in order to slow speeds below 27 miles per hour and reinforce the yielding process. Entry path deflection affects the frequency and severity of collisions between entering and circulating traffic. It is apportioned based on the combination and proportion of the conflicting streams of traffic.

Additional effort to optimize this design will be required for detailed design. The possible modifications include shifts in circle locations, alignment adjustments, development of optimal entry/exit paths, and property access optimization. These geometric considerations affect the safety and capacity performance of roundabouts.

Yours truly,

OURSTON ROUNDABOUT ENGINEERING INC.

Troy Pankratz, P.E.
Project Manager

tp

Figure A1 – Midday 2028 Turning Movements:

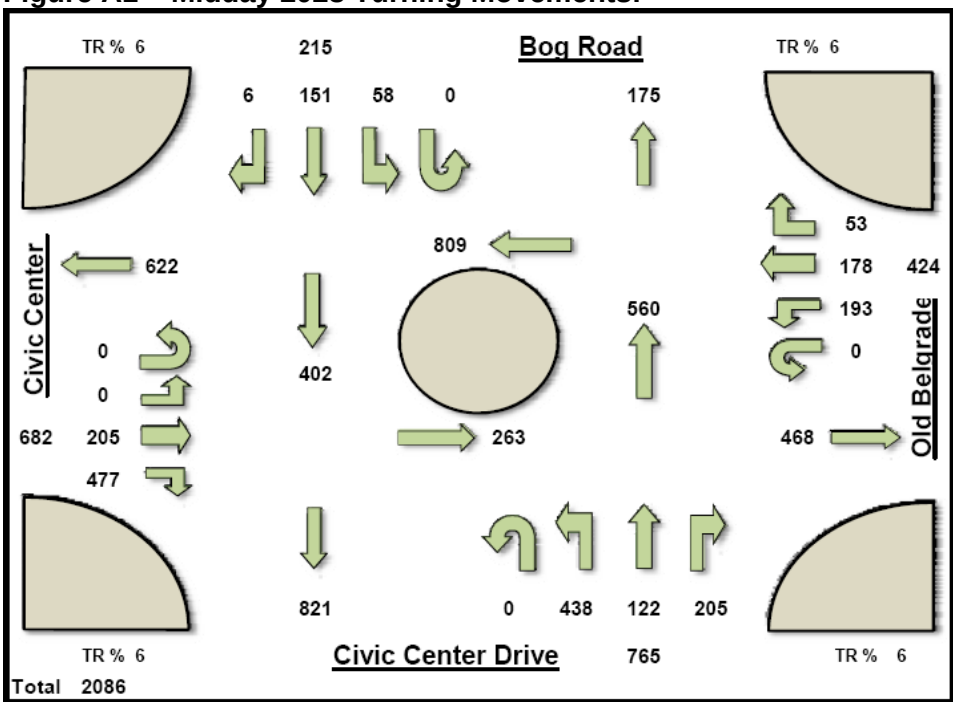


Figure A2 – PM 2028 Turning Movements:

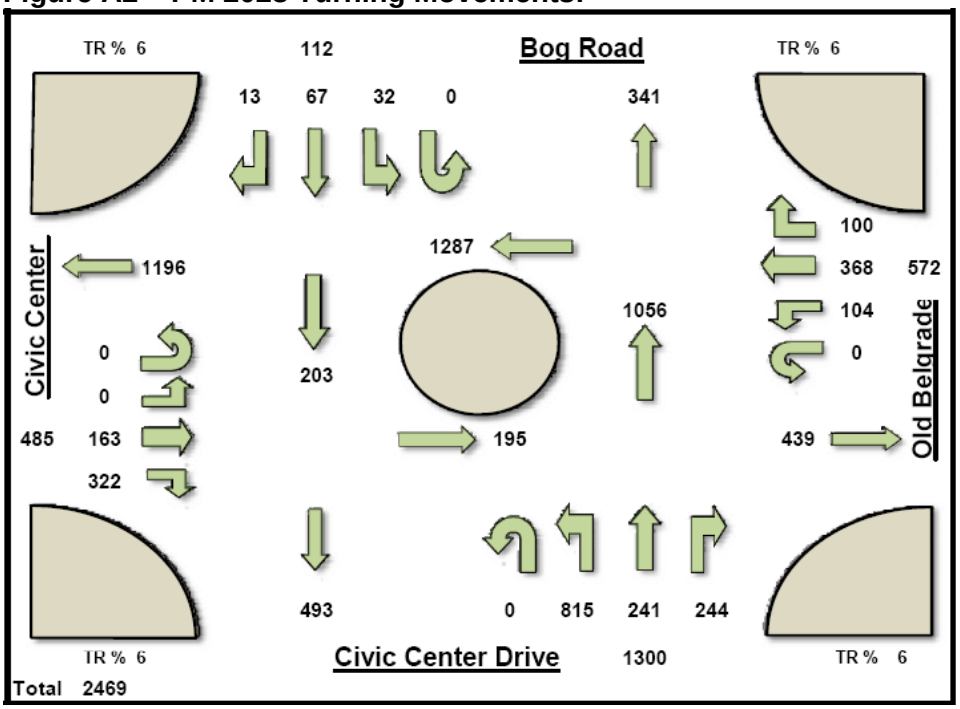


Figure A3 – 2028 Midday Peak Hour - 50% Confidence Level

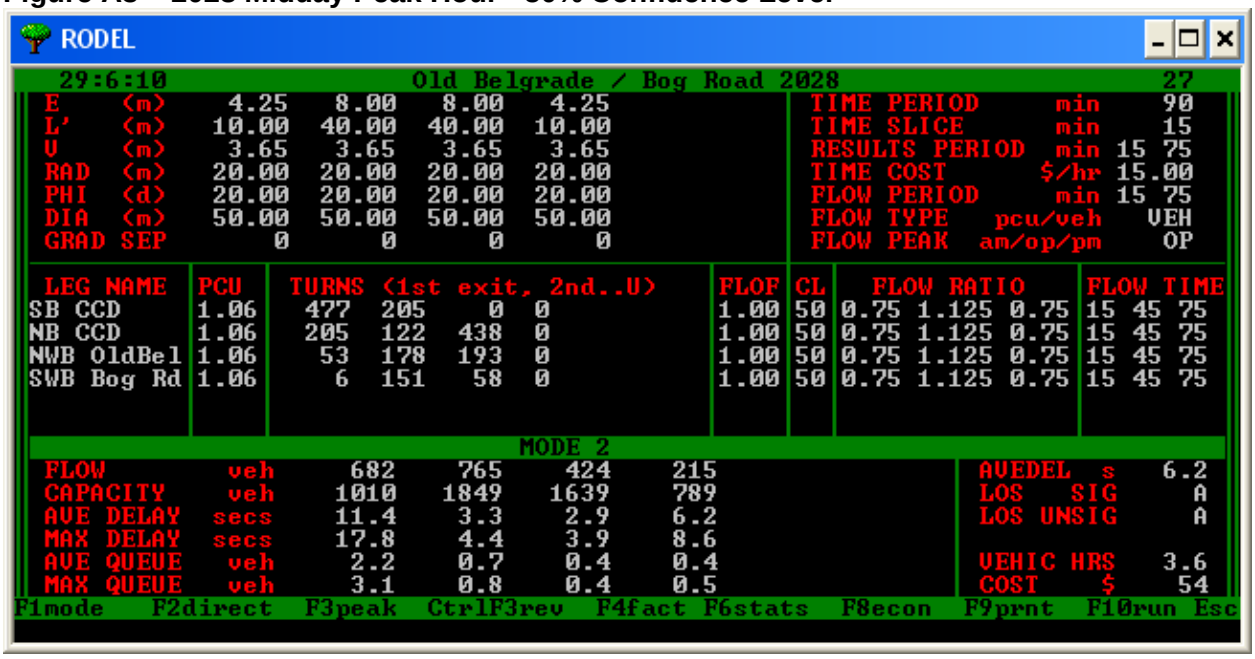


Figure A4 – 2028 Midday Peak Hour - 85% Confidence Level

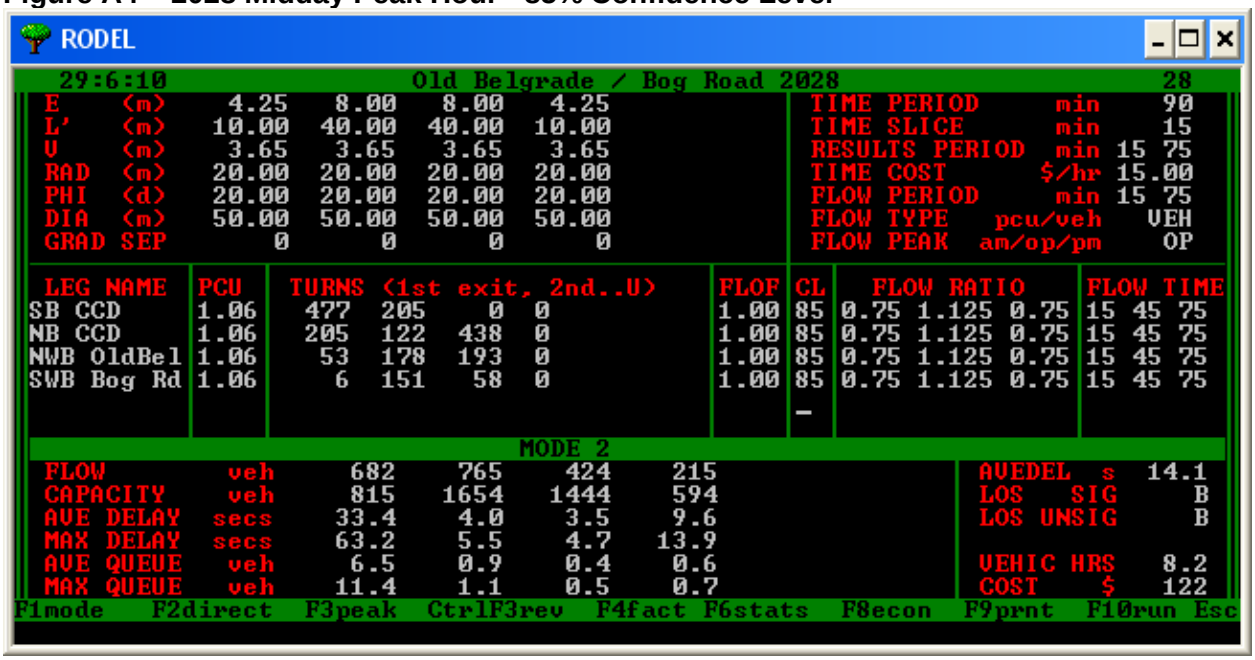


Figure A5 – 2028 PM Peak Hour - 50% Confidence Level

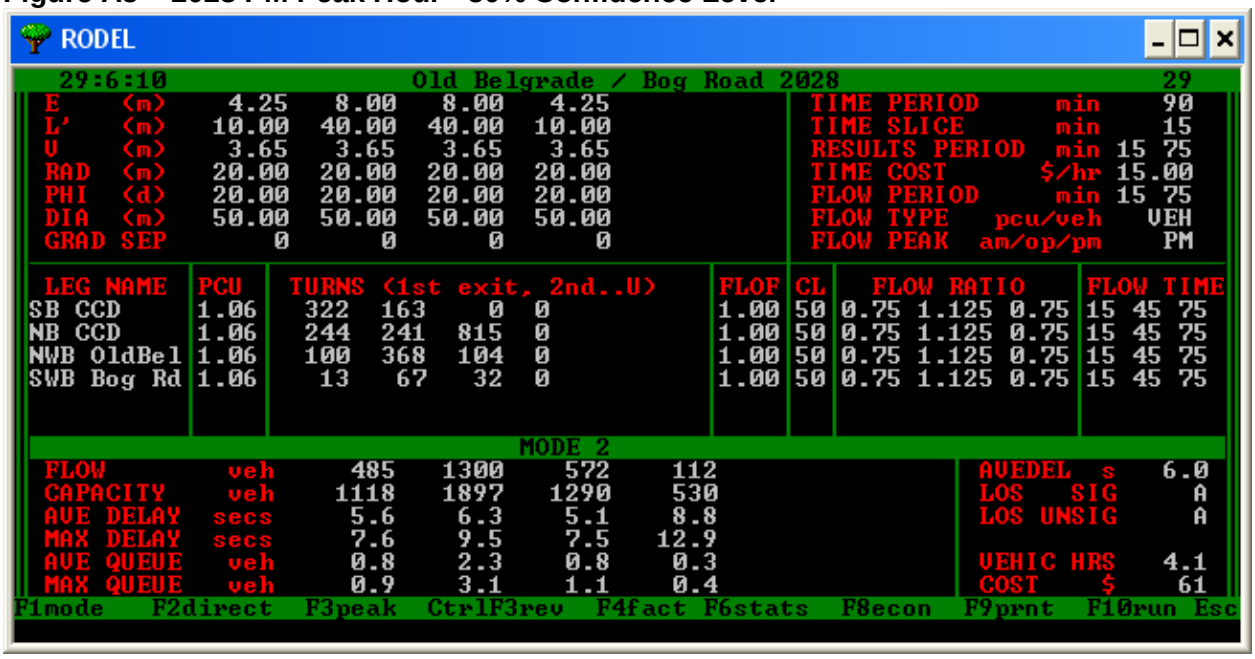
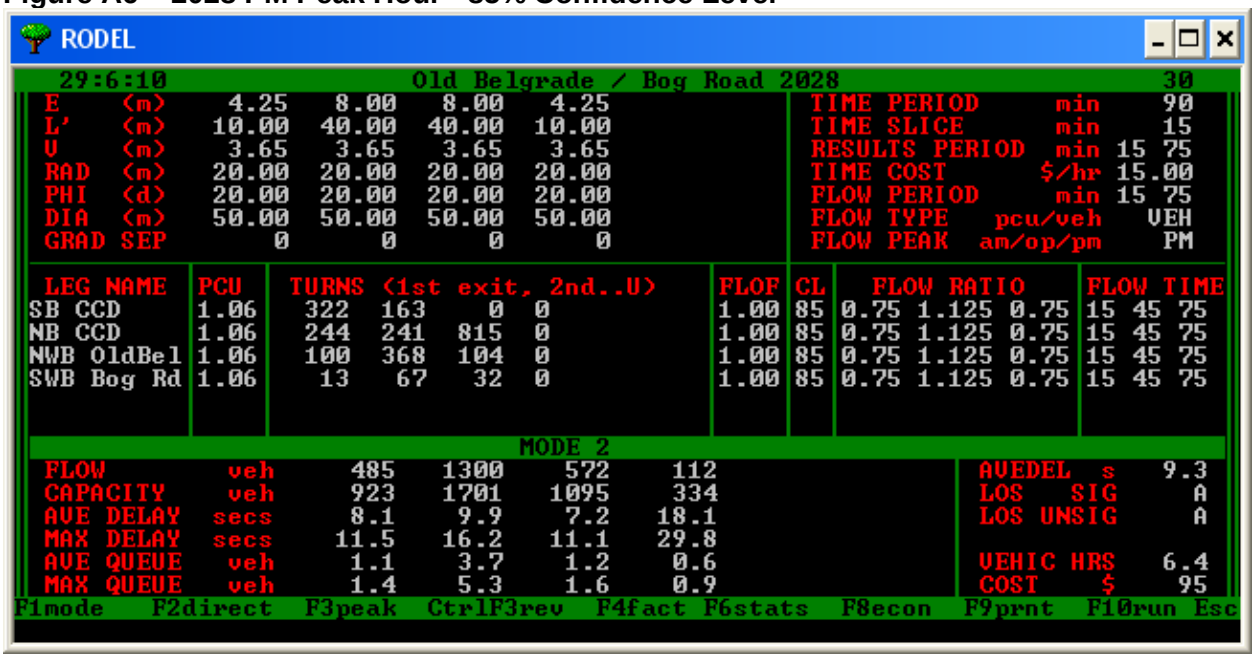


Figure A6 – 2028 PM Peak Hour - 85% Confidence Level



LOS (AVE DELAY IN SEC)

	Midday	PM
50% CONFIDENCE LEVEL	A (6.2) BOG; B (11.4) CCD; A (2.9) O. Belgrade; A (3.3) CCD	A (8.8); A (5.6); A (5.1); A (6.3)
	OVERALL = A (6.2)	OVERALL = A (6.0)
85% CONFIDENCE LEVEL	A (9.6); D (33.4); A (3.5); A (4.0)	C (18.1); A (8.1); A (7.2); A (9.9)
	OVERALL = B (14.1)	OVERALL = A (9.3)

AVERAGE LOS AND DELAY FOR EACH LEG AND FOR THE OVERALL INTERSECTION BASED ON THE 2028 TRAFFIC PROJECTIONS AND CONCEPTUAL LANE CONFIGURATION.

95%ile QUEUE LENGTH

	AM	PM
50% CONFIDENCE LEVEL	50'; 150'; 25'; 25'	50'; 50'; 25'; 75'

AVERAGE 95% PROBABLE QUEUE LENGTHS AT THE 50% CONFIDENCE LEVEL FOR EACH LEG BASED ON THE 2028 TRAFFIC PROJECTIONS AND CONCEPTUAL LANE CONFIGURATION.

V/C RATIO

	AM	PM
50% CONFIDENCE LEVEL	0.27; 0.68; 0.26; 0.41	0.21; 0.43; 0.44; 0.69

AVERAGE V/C RATIOS AT THE 50% CONFIDENCE LEVEL FOR EACH LEG BASED ON THE 2028 TRAFFIC PROJECTIONS AND CONCEPTUAL LANE CONFIGURATION.

RESIDUAL CAPACITY

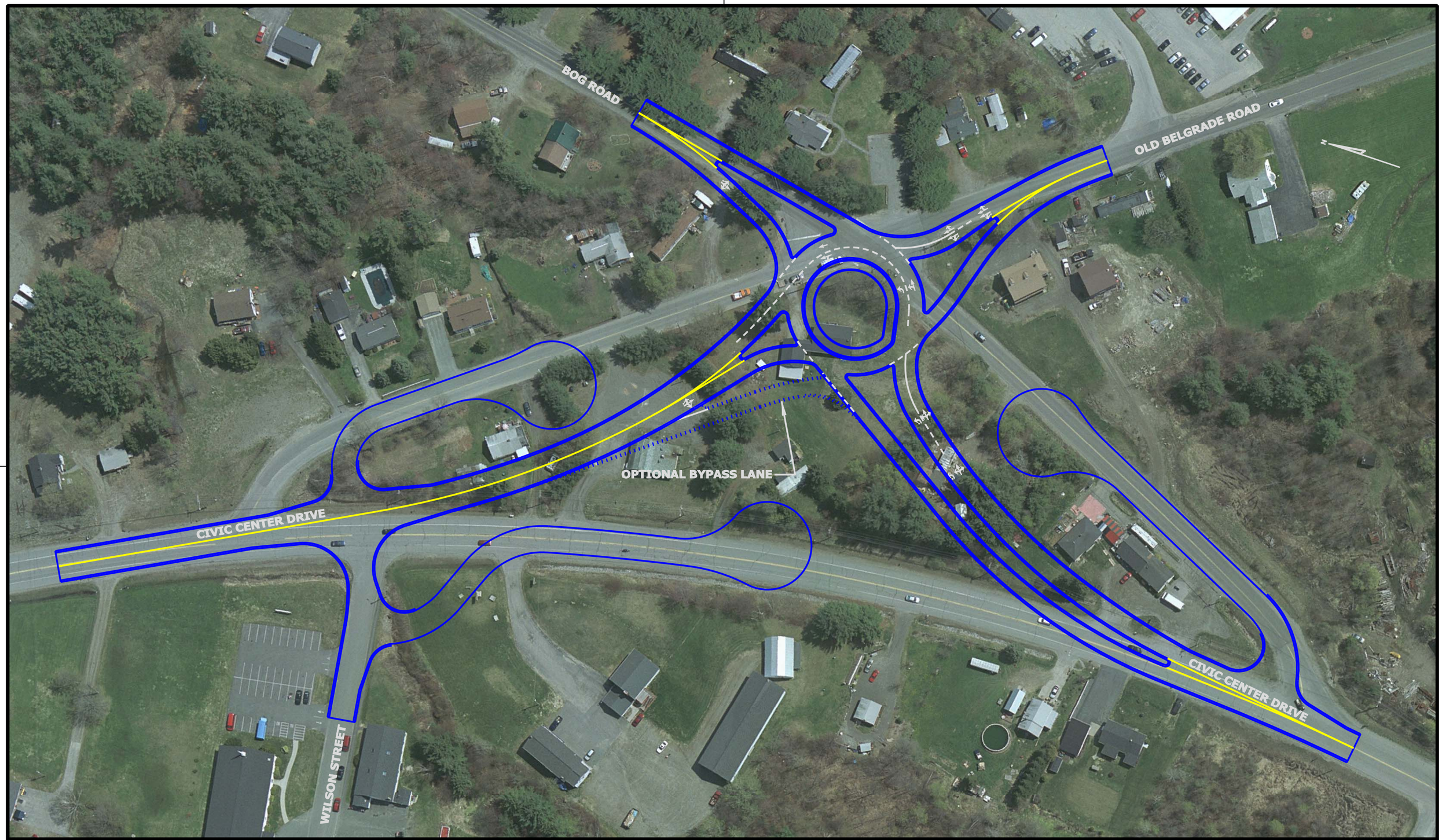
	AM	PM
50% CONFIDENCE LEVEL	X	X
	CRITICAL LEG 22%	CRITICAL LEG 30%

RESIDUAL CAPACITIES EXPRESSED AS THE PERCENTAGE INCREASE IN TOTAL ENTERING TRAFFIC BEYOND THE 2028 PROJECTION THAT WOULD RESULT IN A LEG OPERATING AT LOS E AT THE 50% CONFIDENCE LEVEL.

Ourston Roundabout Engineering

Old Belgrade Rd / Bog Rd
Augusta, Maine
OPERATIONAL ANALYSIS

Figure A7



Augusta North - Augusta, Maine
Civic Center Drive / Old Belgrade Road / Bog Road
Roundabout Conceptual Design - Alternative #1

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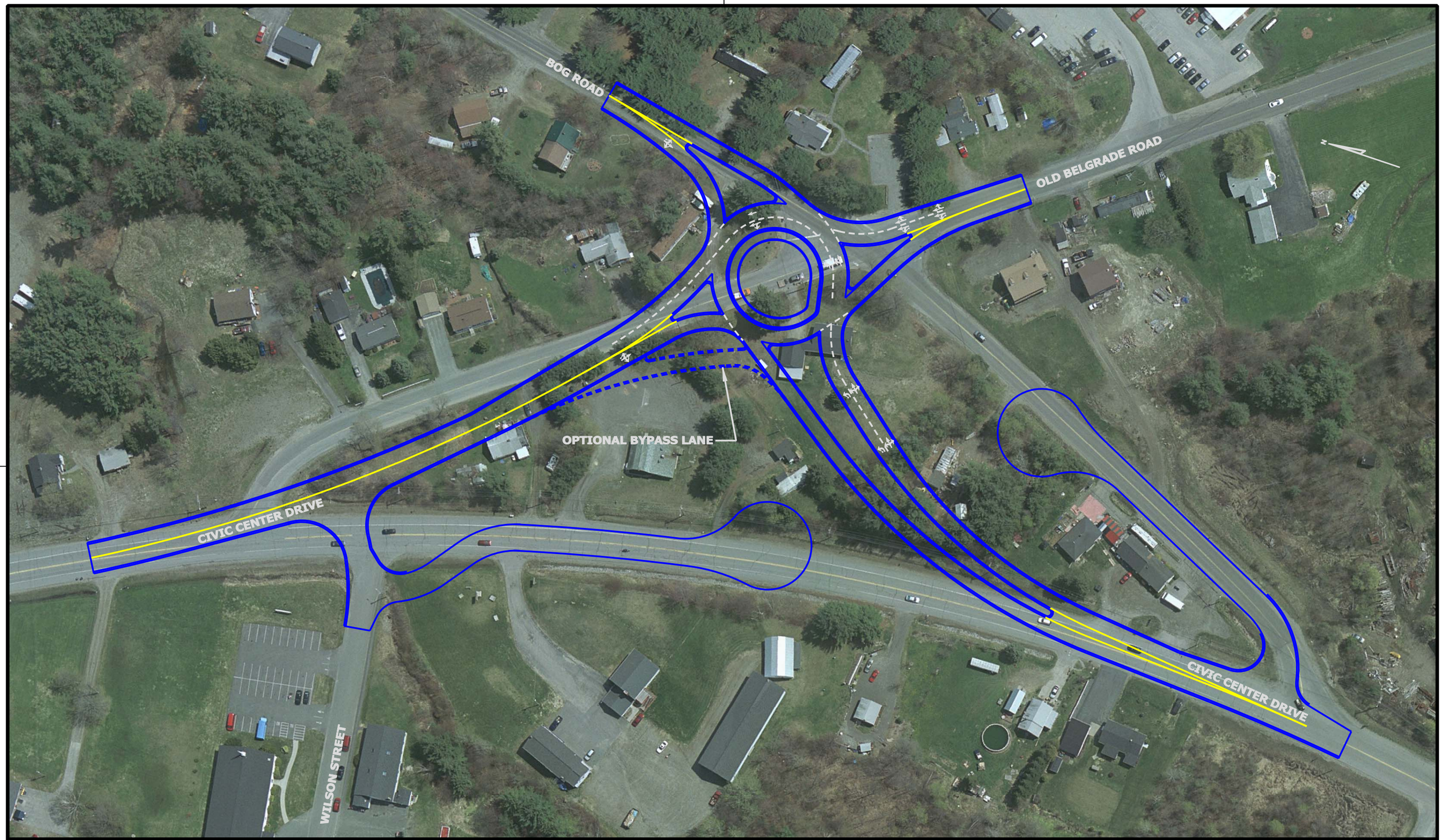
DATE	PROJECT No.
07/16/2010	-
SCALE	FIGURE No.
1"= 100	B1

FILE NAME : $$....designfile....$$

PLOT DATE : $$...plottingdate...$$ PLOT SCALE : $$.....plotscale.....$$



Augusta North - Augusta, Maine
Civic Center Drive / Old Belgrade Road / Bog Road
Roundabout Conceptual Design - Alternative #2

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DATE	PROJECT No.
07/16/2010	-
SCALE	FIGURE No.
1"= 100	B2

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PLOT DATE: $$...plottingdate...$$ PLOT SCALE: $$.....plotscale.....$$